HIFAN 1819 Abs.

Quasi-spherical fuel compression and fast ignition in a heavy-ion-driven X-target with one-sided illumination

by
Enrique Henestroza, B.Grant Logan, L.John Perkins

from
Lawrence Berkeley National Laboratory (on behalf of U.S. HIFS-VNL)
1 Cyclotron Road, Berkeley, CA 94720
Accelerator Fusion Research Division
University of California
Berkeley, California 94720
and
Lawrence Livermore National Laboratory

March 2011

This work was supported by the Director, Office of Science, Office of Fusion Energy Sciences, of the U.S. Department of Energy under Contract No. DE-AC02-05CH11231.

This work was supported by the Director, Office of Science, Office of Fusion Energy Sciences, of the U.S. Department of Energy under Contract No. DE-AC02-05CH11231.

Quasi-spherical fuel compression and fast ignition in a heavy-ion-driven X-target with one-sided illumination

Enrique Henestroza,[1] B.Grant Logan,[1] and L.John Perkins[2]

[1]*Lawrence Berkeley National Laboratory, Berkeley, California 94720, USA*

[2]*Lawrence Livermore National Laboratory, Livermore, California 94550, USA*

ABSTRACT

The HYDRA radiation-hydrodynamics code [M. M. Marinak *et al*, Phys. Plasmas **8**, 2275 (2001)] is used to explore one-sided axial target illumination with annular and solid-profile uranium ion beams at 60 GeV to compress and ignite deuterium-tritium (DT) fuel filling the volume of metal cases with cross sections in the shape of an “X” (X-target). Quasi-three-dimensional, spherical fuel compression of the fuel towards the X-vertex on axis is obtained by controlling the geometry of the case, the timing, power and radii of three annuli of ion beams for compression, and the hydro-effects of those beams heating the case as well as the fuel. Scaling projections suggest that this target may be capable of assembling large fuel masses resulting in high fusion yields at modest drive energies. Initial two-dimensional calculations have achieved fuel compression ratios of up to 150X solid density, with an areal density ρR of about 1 g/cm^2. At these currently modest fuel densities, fast ignition pulses of 3 MJ, 60 GeV, 50 ps, and radius 300 μm are injected through a hole in the X-case on axis to further heat the fuel to propagating burn conditions. The resulting burn waves are observed to propagate throughout the tamped fuel mass, with fusion yields of about 300 MJ. Tamping is found to be important, but radiation drive to be unimportant, to the fuel compression. Rayleigh-Taylor instability mix is found to have minor impact on ignition and subsequent fuel burn up.